Anritsu

GPIB MANUAL

MICROWAVE SYSTEM ANALYZER

ME453K/L/M
ME538K/L/M
(OPTION 04)

NOV. 1992x120 N-33(Y)
Printed in Japan

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SECTION 1 GENERAL

The receiver of the Microwave System Analyzer (MSA) can be remote controlled with GPIB (IEE 488 Bus).

The GPIB system is a general interface bus system for digital equipment approved by IEEE (Institute of Electrical and Electronics Engineers). It standardizes the remote control, data I/O, and data transmission of measurement equipments and peripheral equipments.

With the integration of interface with this specification in controllers and peripheral equipments, each device become fully compatible through the interface connector (specified by IEEE 488).

With this interface bus, a maximum of 15 devices can be connected on 1 bus. Three wire handshake is used for data transmission ensuring transmission between devices with different transmission speed.

1.1 GPIB Interface Capability

MSA (Option 04) has the GPIB interface functions listed in Chart 1-1.

Chart 1-1 GPIB Interface function

Code	Interface Functions
SH1	Have all functions of source handshake
AH1	Have all functions of accepter handshake
T6	Have talker release function with basic talker and MLA command
L4	Have listener release function with basic listener and MTA command
SR0	No service requester function (serial poll)
RL1	Have all remote/local functions
PP0	No parallel poll function
DC1	Have all device clear functions
DT0	No device trigger function
C0	No controller function
E1	Open selector bus driver

Note: The function codes are listed in IEEE488-1978 Appendix C.

1.2 Bus Message

There are 12 types of fundamental messages transmitted across GPIB. The response from MSA to these messages are as shown in Chart 1-2.

Chart 1-2 Bus Messages

(Note) GPIB Address of MSA is 10

GPIB Message	Response from MSA	Related Comments	Interface Functions	Message Type	Sample Statements	
					ANC-BASIC (Packet II)	HPL (9825)
Data	Receives input data and sets front panel functions and prepares for data transmission as shown in section 3. Output data is sent in format shown in section 3.3.		T6 L4 AH1 SH1	Input data	WRITE @110: ...	Wrt 710, ...
				Output data	READ @110: ...	red 710, ...
Trigger	Not used.					
Clear	Initializes data input/output pointer.	DCL	DC1	System Clear	DLC @1	clr 7
		SDC		Device Clear	DLC @110	clr 710
Remote	Control shown in section 2.1 is changed form front panel to GP-IB. However, LOCAL switch is excluded.	REN	RL1	System Remote	REN @1	rem 7
				Device Remote	REN @110	rem 710
Local	Control shown in section 2.1 is changed from GPIB to front panel.	GTL	RL1	System Local	LCL @1	lcl 7
				Device Local	LCL @110	lcl 710
Local Lockout	Pressing of local switch will not return to local.	LLO	RL1		LLO @1	lcl 7
Clear Lockout/ Set Local	Releases local lockout and changes control shown in section 2.1 to front panel.	$\overline{\text{REN}}$	RL1		LCL @1	lcl 7
Require Service	Not used.	SRQ				
Status Byte	Not used.	SPE SPD				
Status Bit	Not used.	PPO				
Pass Control	Not used.	CO				
Abort	Not used.	IFC				

1.3 Specification and Furnished Accessory

With the attachment of option 04, the receiving part of MSA will have the following functions.

1.3.1 Interface bus specifications

(1) General

IEEE Std 488-1978: IEEE Standard Digital Interface for Programmable Instrumentation.

(2) Bus structure

Bus line consists of 16 signal lines and 8 ground lines.

① Data bus (8 lines)
DIO 1 - DIO 8

② Data byte transfer control
DAV, NRFD, NDAC

③ General interface management (5 lines)
ATN, REN, IFC, SRQ, EOI

(3) Data transfer

Three wires handshake: Performed by command
Speed: Less than 1 Mbyte/sec

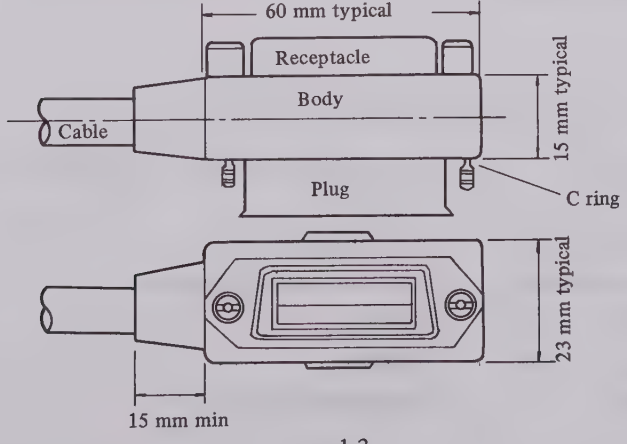
(4) Electrical characteristics

① Digital signal level (Negative logic)
Output 0: ≧1 +2.4 volts
Output 1: ≦1 +0.4 volts
Input 0: ≧1 +2.0 volts
Input 1: ≦1 +0.8 volts

② Power
+5 V ±5 %

(5) Mechanical characteristics

① Cable connector
23 shielded cores wire with 24 pins.



② Cable length

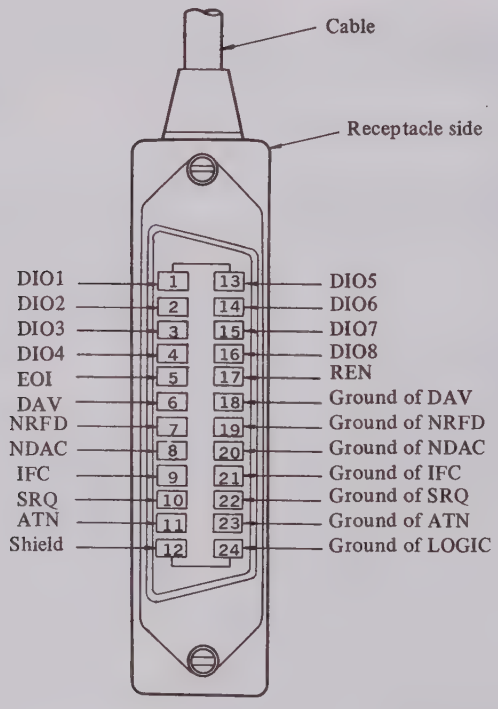
o Cable length should be less than 20 meters at one system configuration.

o Cable length should be followed by the following equation when the number of interface to be connected is less than 10:
L<2N meters.
L ..... Total length of cable
N ..... Number of the interface to be connected

(6) Number of interface

Less than 15 at one system configuration.

(7) Cable connector



1.3.2 GPIB performance of MSA

(1) Listener function

Set the following items with remote control.

①	Measuring items	: Linearity, Delay, Ampl, DG, DP, Return Loss, DC Input
②	Receiver mode	: IF, BB
③	CRT sensitivity	: Auto, Manual
④	Normalizer mode setting	: S/N improvement, subtraction
⑤	P-P function	: ON/OFF
⑥	CAL function	: ON/OFF
⑦	FREQ SELECT	: MARKER/COUNTER

(2) Talker function

The following data can be sent.

① IF/BB input level
② FM deviation
③ BB frequency
④ Sensitivity of CRT
⑤ Measurement result; P-P value
⑥ IF Frequency
⑦ IF Sweep width
⑧ Slide Marker Frequency
⑨ Measurement image on CRT; use the normalized data*
  (i) MEAS memory measurement data
  (ii) STO memory measurement data

Note: The measurement image on CRT can be sent for the following measurement items.
  ⓐ Y1; Linearity/DG, Delay/DP, Ampl, Return Loss
  ⓑ Y2; Linearity/DG, Delay/DP, Ampl, DC
  Measurement image of AM-PM, Spectrum, BB AMPL, BB RETURN LOSS cannot be sent.

In order to send CRT image with GPIB, following condition is necessary.

1) Horizontal axis should be swept by 50 (60) Hz sinusoidal wave

2) CRT horizontal axis should be set to full-scale

3) Transferred CRT image has following error against CRT scale.
Vertical axis: less than 0.2 dB (Approx. 2 mm)
Horizontal axis: less than 0.2 dB (Approx. 2 mm)

1.3.3 Furnished Accessory

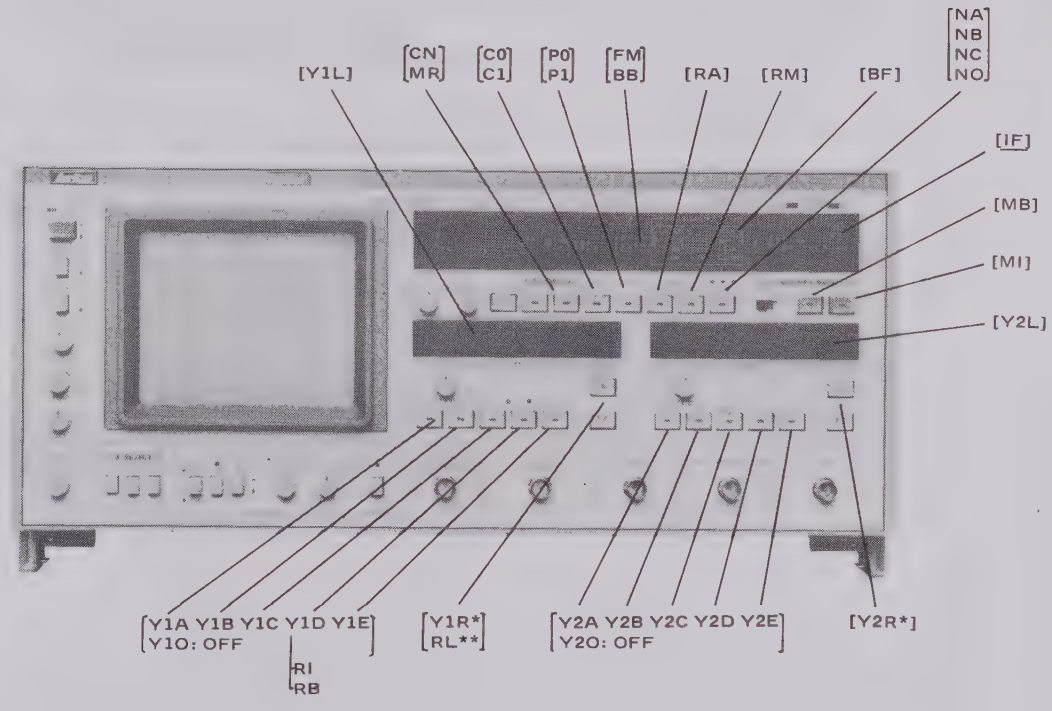
Accessory	Q'ty	Remarks
Operation manual	1	

SECTION 2 PROGRAMMING GUIDE

This manual describes matter pertaining only to remote control using GPIB. Microwave System Analyzer operation manual should be referred to for function of each key, operational sequence and handling of measurement instrument.

2.1 Explanation on Panel

The keys on the front panel and the program code are related as indicated in Figure 2-1. For details on this program code refer to section 3.



2.2 Instrument State

(1) REMOTE/LOCAL

This is the LED indicator to inform whether the instrument is on Remote Mode or Local Mode.

(2) Local Switch

This switch is to be used for changing the instrument in remote mode to Local Mode.

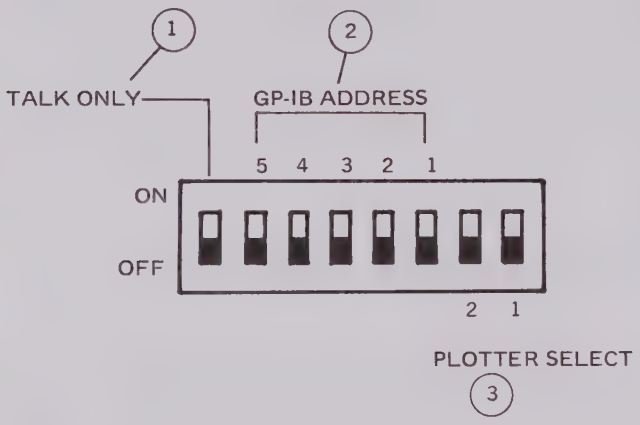
When the instrument is in Local Lockout.

Mode status, Remote Mode cannot be altered to Local Mode. Refer to Clear Lockout in Item 1.2 for detail in this case.

Note: This switch functions as CAL switch when the instrument is in LOCAL mode status.

2.3 Address Switch

Address is set in the following manner on the address switches on the rear panel:



No.	Marking	Description
①	TALK ONLY OFF ON	This is the GP-IB address settable state. The address is set with the GP-IB ADDRESS switches. The talk only mode is set. This device is fixed as the talker without regard to the setting of the GP-IB address switches. (Used when plotting directly at the plotter/printer without going through the controller.)
②	GP-IB ADDRESS	These switches set the GP-IB address of this device. Thirty-one addresses from 0 to 30 can be selected.
③	PLOTTER SELECT	When plotting directly at the plotter without going through the controller, this switch must be selected according to the kind of plotter. (For further information, refer to Direct Plotting [4] of the operation manual.)

GP-IB ADDRESS					5-BIT DECIMAL CODE
5	4	3	2	1	
0	0	0	0	0	00
0	0	0	0	1	01
0	0	0	1	0	02
0	0	0	1	1	03
0	0	1	0	0	04
0	0	1	0	1	05
0	0	1	1	0	06
0	0	1	1	1	07
0	1	0	0	0	08
0	1	0	0	1	09
0	1	0	1	0	10
0	1	0	1	1	11
0	1	1	0	0	12
0	1	1	0	1	13
0	1	1	1	0	14
0	1	1	1	1	15
1	0	0	0	0	16
1	0	0	0	1	17
1	0	0	1	0	18
1	0	0	1	1	19
1	0	1	0	0	20
1	0	1	0	1	21
1	0	1	1	0	22
1	0	1	1	1	23
1	1	0	0	0	24
1	1	0	0	1	25
1	1	0	1	0	26
1	1	0	1	1	27
1	1	1	0	0	28
1	1	1	0	1	29
1	1	1	1	0	30

Note 1: ON
0: OFF

SECTION 3 PROGRAMMING

A list of MSA program codes is shown in section 3.1. Using these codes, setting equivalent to LOCAL using key switch can be made.

The program codes of MSA can be divided into the following 3 types.

(1) Codes for setting function

(2) Codes for sending measured data

(3) Other codes

When the code for sending measured data is received, send preparation is performed with the data at that time and when the MSA is specified as the talker and the data is requested, this data is sent in format shown in section 3.3.

Sending of measured image on CRT is performed using the normalizer function by converting the measured image to digital value. For detail of this procedure, see section 3.3.6.

When the measurement items or other functions of this MSA are switched, a little time is necessary for the measurement data to stabilize. Take this into account when programming.

3.1 List of Program Codes

3.1.1 Setting of functions

CODE	DESCRIPTION	Remarks
	1. Setting of Y1 Measuring Items	See section 3.2.1
Y1A	(1) Linearity/DG	
Y1B	(2) Delay/DP	
Y1C	(3) AMPL	
Y1D	(4) Return loss	
Y1E	(5) AM-PM (Measurement image cannot be sent)	
Y1O	(6) OFF	
	2. Setting of Y2 Measuring Items	See section 3.2.2
Y2A	(1) Linearity/DG	
Y2B	(2) Delay/DP	
Y2C	(3) AMPL	
Y2D	(4) Return Loss	
Y2E	(5) Spectrum (Measurement image cannot be sent)	
Y2O	(6) OFF	
	3. Setting of RECEIVER MODE	See section 3.2.3
MI	(1) IF	
MB	(2) BB	
	4. Setting of RANGE MODE	See section 3.2.4
RA	(1) AUTO	
RM	(2) MANUAL	
	5. Setting of PEAK TO PEAK (p-p)	See section 3.2.5
P0	(1) OFF	
P1	(2) ON	
	6. Setting of NORMALIZER	See section 3.2.6
NA	(1) AVG (STO)	
NB	(2) Y-STO	
NC	(3) AVG-STO	
NO	(4) OFF	
	7. Setting of CAL	See section 3.2.7
C0	(1) OFF	
C1	(2) ON	
	8. Setting of CRT SENSITIVITY (RANGE)	See section 3.2.8
Y1R*	(1) Y1 CRT SENSITIVITY	
Y2R*	(2) Y2 CRT SENSITIVITY	
	9. Setting of RETURN LOSS OFFSET	See section 3.2.9
RL**		

CODE	DESCRIPTION	Remarks
	10. Setting of IF counter/frequency marker	See section 3.2.10.
CN	① IF counter, sweep width	
MR	② Marker	
	11. In return loss measurement, IF/BB made is set. At this time, RECEIVER MODE must be set to BB and Y1 measurement item must be set to RET. LOSS.	See section 3.2.11.
RI	① IF return loss measurement	
RB	② BB return loss measurement	
	12. CRT sensitivity of IF return loss measurement	See section 3.2.12.
Y1R4	① 1 dB/div.	
Y1R6	② 5 dB/div.	

3.1.2 Sending of data

Upon receiving the following commands, the MSA prepares for sending of data and when it is specified as the talker the data is sent.

CODE	DESCRIPTION	NOTE
IF	1. IF INPUT LEVEL	See section 3.3.1
FM	2. FM DEVIATION	See section 3.3.2
BB	3. BB INPUT LEVEL	See section 3.3.3
BF	4. BB FREQUENCY	See section 3.3.4
	5. LED DISPLAY Data	See section 3.3.5
Y1L	① Y1 LED DISPLAY	
Y2L	② Y2 LED DISPLAY	
	6. Send the measured data on CRT	See section 3.3.6
Y1M***	① MEAS Memory Data of Y1	
Y1S***	② STO Memory Data of Y1	
Y2M***	③ MEAS Memory Data of Y2	
Y2S***	④ STO Memory Data of Y2	
CF	7. IF Frequency	See section 3.3.7
MF	8. Slide Marker Frequency	See section 3.3.8
SW	9. IF Sweep Width	See section 3.3.9

3.1 List of Program Codes

3.1.1 Setting of functions

CODE	DESCRIPTION	Remarks
	1. Setting of Y1 Measuring Items	See section 3.2.1
Y1A	(1) Linearity/DG	
Y1B	(2) Delay/DP	
Y1C	(3) AMPL	
Y1D	(4) Return loss	
Y1E	(5) AM-PM (Measurement image cannot be sent)	
Y1O	(6) OFF	
	2. Setting of Y2 Measuring Items	See section 3.2.2
Y2A	(1) Linearity/DG	
Y2B	(2) Delay/DP	
Y2C	(3) AMPL	
Y2D	(4) Return Loss	
Y2E	(5) Spectrum (Measurement image cannot be sent)	
Y2O	(6) OFF	
	3. Setting of RECEIVER MODE	See section 3.2.3
MI	(1) IF	
MB	(2) BB	
	4. Setting of RANGE MODE	See section 3.2.4
RA	(1) AUTO	
RM	(2) MANUAL	
	5. Setting of PEAK TO PEAK (p-p)	See section 3.2.5
P0	(1) OFF	
P1	(2) ON	
	6. Setting of NORMALIZER	See section 3.2.6
NA	(1) AVG (STO)	
NB	(2) Y-STO	
NC	(3) AVG-STO	
NO	(4) OFF	
	7. Setting of CAL	See section 3.2.7
C0	(1) OFF	
C1	(2) ON	
	8. Setting of CRT SENSITIVITY (RANGE)	See section 3.2.8
Y1R*	(1) Y1 CRT SENSITIVITY	
Y2R*	(2) Y2 CRT SENSITIVITY	
	9. Setting of RETURN LOSS OFFSET	See section 3.2.9
RL**		

CODE	DESCRIPTION	Remarks
CN MR	10. Setting of IF counter/frequency marker ① IF counter, sweep width ② Marker	See section 3.2.10.
RI RB	11. In return loss measurement, IF/BB made is set. At this time, RECEIVER MODE must be set to BB and Y1 measurement item must be set to RET. LOSS. ① IF return loss measurement ② BB return loss measurement	See section 3.2.11.
Y1R4 Y1R6	12. CRT sensitivity of IF return loss measurement ① 1 dB/div. ② 5 dB/div.	See section 3.2.12.

3.1.2 Sending of data

Upon receiving the following commands, the MSA prepares for sending of data and when it is specified as the talker the data is sent.

CODE	DESCRIPTION	NOTE
IF	1. IF INPUT LEVEL	See section 3.3.1
FM	2. FM DEVIATION	See section 3.3.2
BB	3. BB INPUT LEVEL	See section 3.3.3
BF	4. BB FREQUENCY	See section 3.3.4
Y1L Y2L	5. LED DISPLAY Data ① Y1 LED DISPLAY ② Y2 LED DISPLAY	See section 3.3.5
Y1M*** Y1S*** Y2M*** Y2S***	6. Send the measured data on CRT ① MEAS Memory Data of Y1 ② STO Memory Data of Y1 ③ MEAS Memory Data of Y2 ④ STO Memory Data of Y2	See section 3.3.6
CF	7. IF Frequency	See section 3.3.7
MF	8. Slide Marker Frequency	See section 3.3.8
SW	9. IF Sweep Width	See section 3.3.9

3.1.3 Other codes

CODE	DESCRIPTION	NOTE
MOV	1. Transmit AVG memory data to memory for GPIB. The normalized measurement image at the time this command is received is sent with the command No. 6 in section 3.1.2, (example for Y1 channel: Y1M***) when specified as the talker.	See section 3.3.6
AS	2. Prepare to send setting data for all functions.	See section 3.4.1
TL	3. Title display on CRT	See section 3.4.2.
ETL	4. Erasing of title	See section 3.4.3.
GA Xn, Yn GB Xn, Yn	5. Displaying reference line on CRT	See section 3.4.4.

3.2 Program Codes for Setting Front Panel Key

To set MSA through GPIB, the following program code must be sent in the same sequence as for manual setting (LOCAL Operation). To show the end of data, LF or EOI is required as delimiter.

3.2.1 Setting of Y1 Measuring Item

(1) Program Code

① Linearity/DG Y1A
② Delay/DP Y1B
③ AMPL Y1C
④ Return Loss Y1D
⑤ AM-PM Y1E
⑥ OFF Y1O

(2) Note

① Measurement image for AM-PM conversion cannot be sent.
② Measurement image for BB Ample and BB return loss cannot be sent.

3.2.2 Setting of Y2 Measuring Item

(1) Program code

① Linearity/DG Y2A
② Delay/DP Y2B
③ AMPL Y2C
④ DC Y2D
⑤ Spectrum Y2E
⑥ OFF Y2O

(2) Note

① Measurement image of spectrum cannot be sent.
② Measurement image of BB Ample cannot be sent.

3.2.3 Setting of receiver mode

① IF . . . . . MI
② BB . . . . . MB

3.2.4 Setting of range mode

(1) Program code

① AUTO . . . . . RA
② MANUAL . . . . . RM

(2) Note

① AUTO cannot be set when the normalizer is set to Y-STO or AVG-STO. As in LOCAL operation, the key lamp blinks to notify the error but no comment is sent to the controller.

3.2.5 Setting of peak to peak (p-p)

(1) Program code

① OFF P0
② ON P1

(2) Note

① P-P cannot be set when the normalizer is set to Y-STO or AVG-STO. As in LOCAL operation, the key lamp blinks to notify the setting error, but no comment is sent to the controller.

3.2.6 Setting of normalizer

(1) Program code

① AVG (STO) . . . . . NA
② Y-STO . . . . . NB
③ AVG-STO . . . . . NC
④ OFF . . . . . NO

(2) Concerning AVG Memory and STO memory

The normalizer function of MSA has 4 memories. The name and operation of these memories are as shown in Chart 3-1. Standard data such as internal deviation is written in STO (INT) memory. For method of reading data from the memory, see section 3.3.6.

Chart 3-1

Channel	Name of memory	Application of memory	Normalyzer			
			AVG (STO)	Y-STO	AVG-STO	OFF
Y1	AVG (MEAS)	Measurement image store	Write	Hold	Write	Hold
	STO	Internal store	Write	Hold	Hold	Hold
Y2	AVG (MEAS)	Measurement image store	Write	Hold	Write	Hold
	STO	Internal store	Write	Hold	Hold	Hold

Note: AVG (STO) holds all memories for 2 seconds after switch is changed. STO memory data is not changed if switch is changed to next step within 2 seconds.

(3) Concerning averaging speed

① Normal response time: Maximum approximately 90 seconds. It takes a maximum of approximately 90 seconds to converge when the signal is changed during AVG (STO) operation.

② By turning the normalizer off once, the time until convergence is descreased.
When the normalizer is changed from OFF to ON approximately 12 seconds, rough averaging is performed for the first few seconds to decrease the time till convergence.
When switching measurement item or when the input signal changes, resetting, after turning off the normalizer once (for more than 1 second), will speed up the time till convergence.

(4) Other precautions

① When Y-STO or AVG-STO is selected, P-P always changes to OFF and RANGE mode always changes to manual.

3.2.7 CAL

(1) Program code

① OFF C0

② ON C1

3.2.8 CRT sensitivity

(1) Program code

① Y1 CRT sensitivity . . . . . Y1R* * : RANGE NO.

② Y2 CRT sensitivity Y2R*

(2) Note

① To set CRT sensitivity from outside, the RANGE mode in section 3.2.4 must be set to MANUAL.

② The sensitivity of measurement item selected with Y1/Y2 FUNCTION is set.

③ The value for sensitivity is chosen from the RANGE No. in chart 3-2 and substituted for the * in the code.

④ For example, if Y1: Linearity/DG is set and the range is to be set to 5 %/div, send the code "Y1R6".

Chart 3-2 Ranges and Their Numbers

Items	Units of CRT Sensitivity	RANGE NUMBER								
		0	1	2	3	4	5	6	7	9
Linearity/DG	%/DIV	0.05	0.1	0.2	0.5	1.0	2.0	5.0	10	
Group Delay	ns/DIV	0.5	1.0	2.0	5.0	1.0	2.0	5.0		0.1 (Y2)
DP	DEG/DIV			0.2	0.5	1.0	2.0	5.0		
IF Amplitude	dB/DIV	0.05	0.1	0.2	0.5	1.0	2.0			0.01 (Y2)
BB Amplitude	dB/DIV		0.1	0.2	0.5	1.0				
AMP-PM Coefficient	°/dB/DIV			0.2	0.5	1.0	2.0			
Return Loss (IF)	dB/DIV					1.0		5.0		
DC	mV/DIV		1	2	5	10	20	50	100	
Spectrum	0.25/DIV	Constant								

3.2.9 Return loss offset ..... RL** **: data

① This code is valid for Y1 Measuring Items: Return Loss, RANGE: MANUAL. For RANGE: AUTO, it is automatically set by the device itself.

② The range of Return Loss offset data is as follows:

IF Return Loss: 14 to 46 dB, 1 dB step

Example Set the center of CRT scale to Return Loss 30 dB. RL30

3.2.10 Setting of IF COUNTER/MARKER

(1) Program code

① IF counter, sweep width ..... CN

② Marker ..... MR

3.2.11 Setting of Receiver Mode in Return Loss Measurement

(1) Program code

① IF return loss ..... RI

② BB return loss ..... RB

(2) Note

When the receiving mode is BB, the return loss measurement mode can be switched to the IF band. This command is effective only when the receiving mode is set to BB and the Y1 measurement item is set to RET. LOSS.

3.2.12 CRT Sensitivity of IF Return Loss Measurement

(1) Program code

① CRT sensitivity 1 dB/div. Y1R4

② CRT sensitivity 5 dB/div. Y1R6

(2) Note

This command is effective only when the Y1 measurement item is set to RET. LOSS-IF.

3.3 Sending of Data

The output data of MSA is a combination of 7 bit ISO codes. As a delimiter for marking the end of data, EOI is sent together with LF.

3.3.1 IF Input Level ..... IF

(1) Output data format

① For –20.9 to +10.9 dBm

```
1                 11  15                  26   30      35 36
↓                 ↓   ↓                   ↓    ↓       ↓  ↓
IF_LEVEL__[dBm]_____________ (±) XX.X____CR LF
↑
Space                  10                          EOI is sent together.
```

Note: (+) send space

② For greater than +11 dBm

```
                                        24
                                        ↓
IF_LEVEL__[dBm]_________*__11.0____CR LF
                        ↑
                  8     error mark (shows over-range)
```

③ For less than –21 dBm

```
                                        24
                                        ↓
IF_LEVEL__[dBm]_________*_–21.0____CR LF
                        ↑
                        error mark (shows under-range)
```

④ When there is no input signal

```
                                        24
                                        ↓
IF_LEVEL__[dBm]_________*_–__________CR LF
                        ↑
                        error mark (shows input signal off)
```

(2) Example: GPIB address of MSA is set to the 10

PACKET II (Anritsu)	9825A (HP)
10 DIM A$*40	10 dim A$ [40]
20 WRITE @110: "IF"	20 wrt 710, "IF"
30 READ @110: A$	30 red 710, A$
40 PRINT A$	40 prt A$
50 END	50 end

3.3.2 FM deviation ..... FM

(1) Output data format

① 20.1 kHz rms to 99.0 kHz rms

```
1          11      18          26          35 36 ..... column
↓          ↓       ↓          ↓           ↓  ↓
DEVIATION_[kHz rms]_______XXXX_____CR LF
```

② 100 kHz rms to 999 kHz rms

```
                                26
                                ↓
DEVIATION_[kHz rms]_______XXX_____CR LF
```

③ Greater than 1000 kHz rms

```
                              24 26
                              ↓  ↓
DEVIATION_[kHz rms]_____*_999_____CR LF
                        ↑
                        error mark (shows over-range)
```

④ Less than 20 kHz rms

```
                              24   28
                              ↓    ↓
DEVIATION_[kHz rms]_____*___0_____CR LF
                        ↑
                        error mark (shows under-range)
```

3.3.3 BB Input Level ..... BB

(1) Output data format

① For −50.9 dBm to +10.9 dBm

```
1              11  15                  26     30      35 36
↓              ↓   ↓                   ↓      ↓       ↓  ↓
BB_LEVEL__[dBm]_____________(±) XXXX____CR LF
```

Note: (+) Send space

② For greater than +11 dBm

```
                                       24
                                       ↓
BB_LEVEL__[dBm]_____________*__11.0_____CR LF
                                       ↑
                                       error mark (shows over-range)
```

③ Less than −51 dBm

```
                                       24
                                       ↓
BB_LEVEL__[dBm]_____________*_-51.0_____CR LF
                                       ↑
                                       error mark (shows under-range)
```

3.3.4 BB Frequency ..... BF

(1) Output data format

① When receiving the frequencies shown in the following chart.

```
1              10  14                  26     30      35 36
↓              ↓   ↓                   ↓      ↓       ↓  ↓
BB_FREQ__[kHz]_____________XXXXX_____CR LF
                 \_____11_____/
```

② When there is no BB signal (or when receiving BB signal other thand those shown in the following chart).

```
1              10  14                  24
↓              ↓   ↓                   ↓
BB_FREQ__[kHz]_____________*_____________CR LF
                                       ↑
                                       error mark
```

(2) BB frequencies that can be tuned in.

	ME453 K ME538 K	ME453 L ME538 L	ME453 M ME538 M
f1	63.3 kHz	92.6 kHz	83.3 kHz
f2	200 kHz	278 kHz	250 kHz
f3	400 kHz	556 kHz	500 kHz
f4	2 MHz	2.4 MHz	2.4 MHz
f5	3.58 MHz		
f6	4.43 MHz		
f7	5.6 MHz		
f8	8.2 MHz		
f9	12.39 MHz (ME538K/L/M only)		

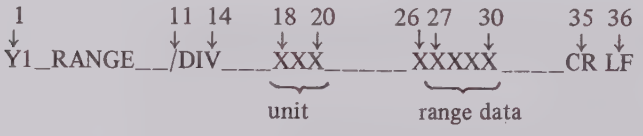
3.3.5 Sending of Y1/Y2 LED display data (RANGE, P-P value)

Y1 LED Display Y1L
Y2 LED Display Y2L

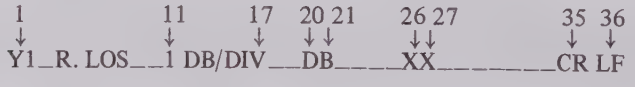
(1) Sending of Y1 CRT sensitivity Y1L

① Condition: P-P function must be OFF.

② Output data format



For RET. LOSS 1 dB/DIV

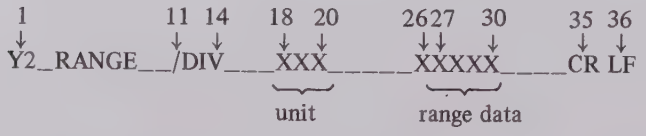


③ Note: The unit is determined by the measurement item. (measurement item to which the Y1 function is set when Y1L command is received). This relation is shown in Chart 3-2.

(2) Sending of Y2 CRT sensitivity Y2L

① Condition: P-P function must be OFF.

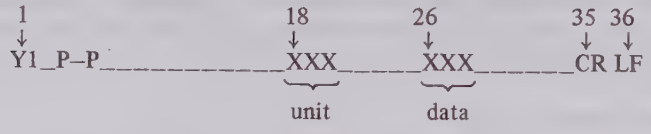
② Output data format



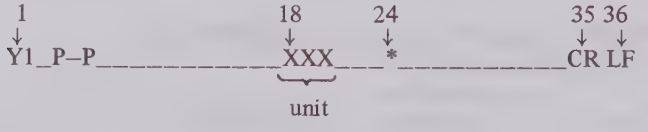
(3) Sending of P-P value of measurement image on Y1 CRT Y1L

① Condition: P-P function must be ON

② Output data format



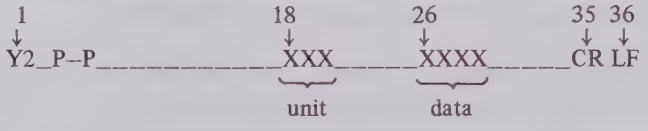
③ Output data format: in the case of over-range



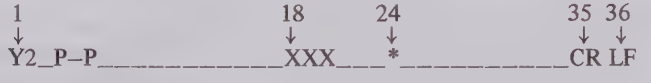
(4) Sending of P-P value measurement image on Y2 CRT Y2L

① Condition: P-P function must be ON

② Output data format



③ Output data format: in the case of over-range



3.3.6 Sending of measurement image on CRT

When sending the measurement image on the CRT from the MSA to the controller through the GPIB interface, the following 4 steps are required.

(i) Convert the measured image to digital signal using the normalizer function (see section 3.2.6)

(ii) Use the "MOV" transmission command and transmit the digital signal in memory to the GPIB, memory of MSA.
The measured image at this point is sent to the controller with the commands from (iii). (see (1) in this section)

(iii) Use data send preparation command (example Y1M***) and prepare data to be sent. (see (2) in this section)

(iv) Specify MSA as talker.
The actual operation is shown in (3).

(1) Command for transmitting AVG memory data . . . . . MOV

One of the commands used when sending the measurement image on the CRT of MSA to the controller through GPIB interface. When the normalizer function is used to convert the measured image to digital signal, the data is stored in AVG memory. This command is used to transmit this data to GPIB memory. The normalizer function continues the averaging of measurement image on CRT, but when this MOV command is received, averaging is stopped and the data in the AVG memory is transmitted to the GPIB memory.

(2) Data send preparation command

① Command code

(i) MEAS MEMORY data of Y1 channel Y1M***
***: CRT X axis address (item (3))

(ii) STO MEMORY data of Y1 channel Y1S***

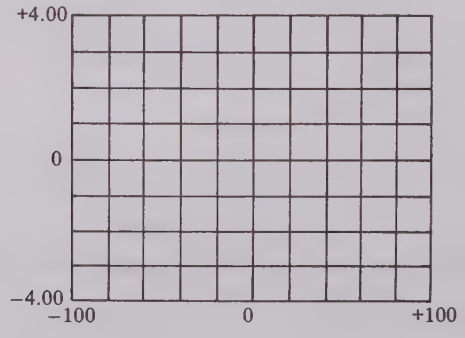
(iii) MEAS MEMORY data of Y2 channel Y2M***

(iv) STO MEMORY data of Y2 channel Y2S***
Note: ***: address data

② Displaying of X axis address on CRT and measurement value on Y axis

The measurement image on the CRT can be sent with the resolution of 201 points on the X axis and 801 points on the Y axis. This setting is shown in Fig. 3-1.

Fig. 3-1 Setting of X/Y CRT Scales



X axis: −100 – +100
Center should be 0.
Minimum step 1.

Y axis: −4.00 – +4.00
Center should be 0.
Minimum step 0.01

(3) Address setting when the controller read out data.

In order to read out the measurement image using MOV command data is read out by transmitting data of measured image into GPIB memory is performed at first, and setting CRT Y axis address.

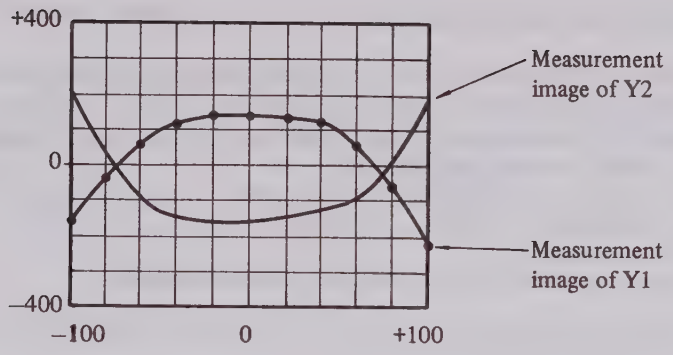


Fig. 3-2 Example of measurement image on CRT

Address setting example for reading out measurement image Y1 in Chart 3-2. The controller set address as chart 3-3 using command which is discribed in 3.3.6 (2) (i). After that, Y axis data in each address is sent by specifying MSA as talker. Chart 3-3 shows data sending example with 1 div Y-axis address setting.

X-axis address from controller to MSA (for Y1 channel, MEAS memory)	Y-axis data from MSA to controller (data format is in accordance with item 4)
Y1M-100	–1.70
Y1M-80	–0.40
Y1M-60	+0.70
Y1M-40	+1.10
Y1M-20	+1.20
Y1M0	+1.20
Y1M20	+1.20
Y1M40	+1.10
Y1M60	+0.50
Y1M80	–0.70
Y1M100	–2.20

(4) Output data format

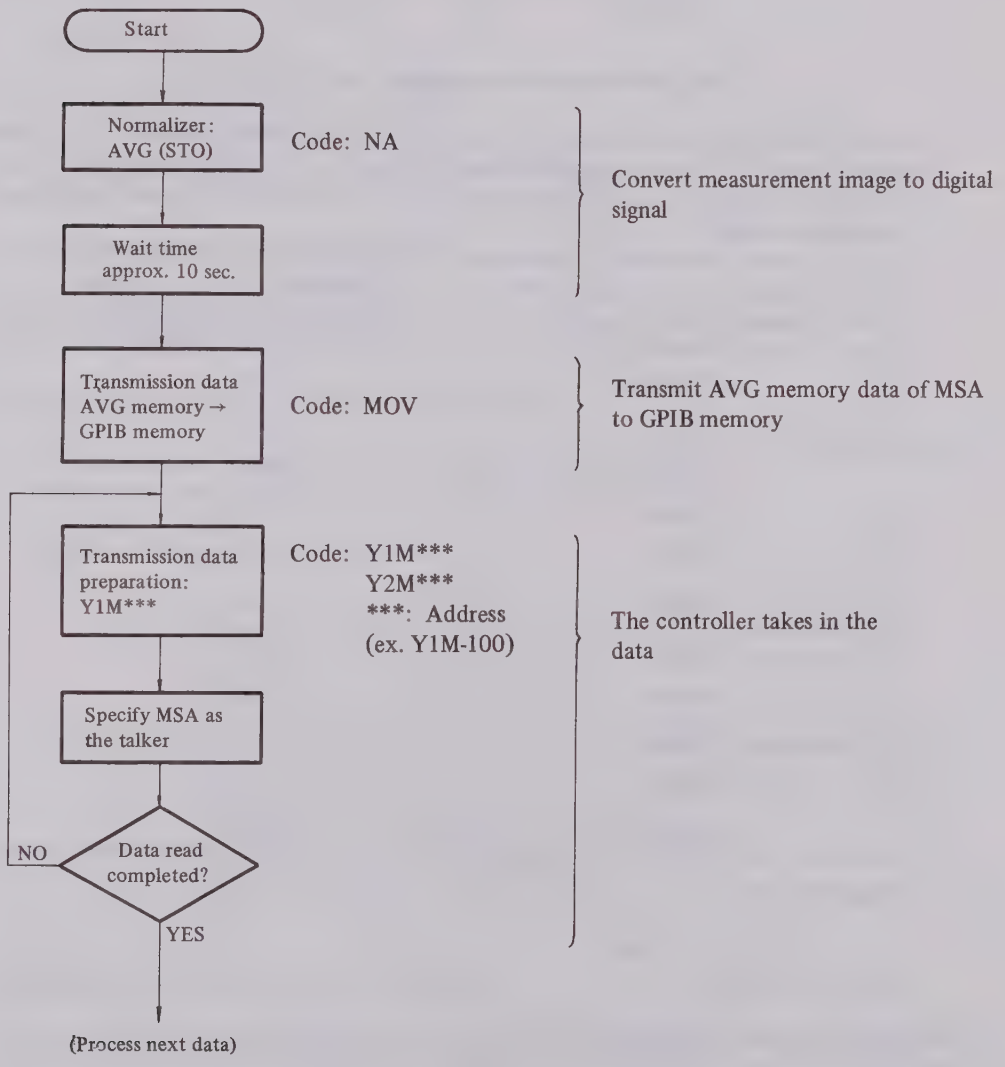
```
1          5  6  7    Colum
↓          ↓  ↓  ↓
* * * * *  CR LF
```

Note: * * * * *: Y-axis data

(5) Example of measurement image reading

As previously mentioned, in order to send the measurement image on the CRT of MSA to the controller through GPIB the measured image must be converted to digital signal.
The speed of this conversion to digital signal can be increased by turning the Normalizer OFF and then ON again as stated in section 3.2.6.
Taking these into consideration, the flowchart for a controller program to read the measurement image is as follows:

3-2 One example of flow-chart for sending measurement image



3.3.7 Sending of IF Center Frequency ..... CF

Before using this command, select the IF counter mode.

(1) Output data format

```
 1  4  7  10  14                 26     31     35 36
 ↓  ↓  ↓  ↓   ↓                  ↓      ↓      ↓  ↓
CF_FREQ__[MHz]_____________XXXXXX___CR LF
```

3.3.8 Sending of Slide Marker Frequency ..... MF

Before using this command, select the marker mode.

(1) Output data format

```
1    5      10  14  18          26   30      35 36
↓    ↓      ↓   ↓   ↓           ↓    ↓       ↓  ↓
SLD_MRK__+/-_[MHz]_______XXXXX____CR LF
```

3.3.9 Sending of IF Sweep Width ..... SW

Before using this command, select the IF counter mode.

(1) Output data format

```
1      6      11  15            26   29      35 36
↓      ↓      ↓   ↓             ↓    ↓       ↓  ↓
SWP__+/-__[MHz]_____________XXXX_____CR LF
```

3.4 Other Codes

3.4.1 Sending of ALL SETTING FUNCTION data

Command code for notifying the following status of function to the controller.

Function and its Status

Name of Function	Status Set	Status to be Sent
Y1	Linearity/DG	Y1A
	Delay/DP	Y1B
	Ampl	Y1C
	Return Loss	Y1D
	AM-PM	Y1E
	OFF	Y1O
Y2	Linearity/DG	Y2A
	Delay/DP	Y2B
	Ampl	Y2C
	DC	Y2D
	Spectrum	Y2E
	OFF	Y2O
Receiver Mode	IF	MI
	BB	MB
Range Mode	Auto	RA
	Manual	RM
P-P	OFF	0
	ON	1
Normalizer	AVG (STO)	NA
	Y-STO	NB
	AVG-STO	NC
	OFF	N0
CAL	OFF	0
	ON	1
FREQ SELECT	COUNTER	CN
	MARKER	MR
RET. LOSS mode	IF RETURN LOSS	RI
	BB RETURN LOSS	RB

(1) Output format

```
 2  4  6 8    11     15     19     23     27  30  33  35 36
 ↓  ↓  ↓ ↓    ↓      ↓      ↓      ↓      ↓   ↓   ↓   ↓  ↓
_Y1X,Y2X,_MX,_RX,_PX,_NX,_CX,CN,RI,CR LF
```

3.4.2 Display Title on CRT ..... TL

This is used when displaying a text (title, etc.) on the CRT.

(1) Program code

TL*** *: Data, maximum 20 characters

(2) Usable characters

0 to 9, A to Z, *, +, –, /, blank,.

(3) Note

① When the number of characters is 20 or less, enter [,] at the end.

TL*****, (5 characters) → [,] is entered.

If this [,] is not entered, part of the previously displayed data will remain on the CRT.

② When the number of characters exceeds 20, the part exceeding 20 is ignored.

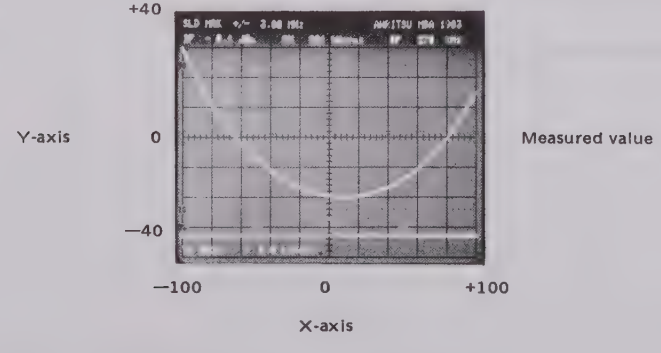
3.4.3 Erasing Title From CRT ..... ETL

This is used to erase the text (title, etc.) displayed on the CRT.

3.4.4 Displaying Reference Lines on CRT

Two reference lines can be displayed on the CRT. The resolution of the CRT is as follows:

1. Measured value



X-axis: –100 to +100, Center ..... 0, Minimum step 1
Y-axis: –40 to +40, Center ..... 0, Minimum step 1

(1) Reference line input program code

① Input reference line A ..... GA Xn, Yn,

② Input reference line B ..... GB Xn, Yn,

Xn = X-axis data, –100 to +100

Yn = Y-axis data, –40 to +40

③ Note

(i) Also enter each GA (or GB) command when reference line data is input continously.

[Example] GA-100, –10, GA–99, –9, GA–98, 8, ...

(ii) Input the X-axis data from the low value.

(iii) If input from halfway in the X-axis, a rising vertical line appears.

Input from –100 of the X-axis, then erase the unwanted values with the blank command described next.

(2) Program code which makes part of the displayed reference lines blank

This is used when entering broken line, etc. as reference lines.

① Make part of reference lines A blank ..... GA Xn, B,

② Make part of reference lines B blank ..... GB Xn, B,

③ Note

(i) When displaying broken line, etc. as reference lines, first input X-axis –100 to +100 (201 points) by GA, GB command, then erase the unwanted parts by blank command (GA Xn, B,).

(3) Erasing displayed reference lines

① Erase reference lines A ..... EGA

② Erase reference lines B ..... EGB

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